Instruction Manual

MODEL 921-4 NOISE SOURCE
AND DOWNCONVERTER

Y441/TRW

MP MASTER
MA29838

Scientific Atlanta

Instruction Manual

MODEL 921-4 NOISE SOURCE
AND DOWNCONVERTER

Y441/TRW

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TRW COMPONENT MANUAL
MODEL 921-4 NOISE SOURCE AND DOWNCONVERTER

April 1980

SCIENTIFIC-ATLANTA
3845 PLEASANTDALE ROAD
ATLANTA, GEORGIA 30340

NOTICE

CHANGE NOTICES

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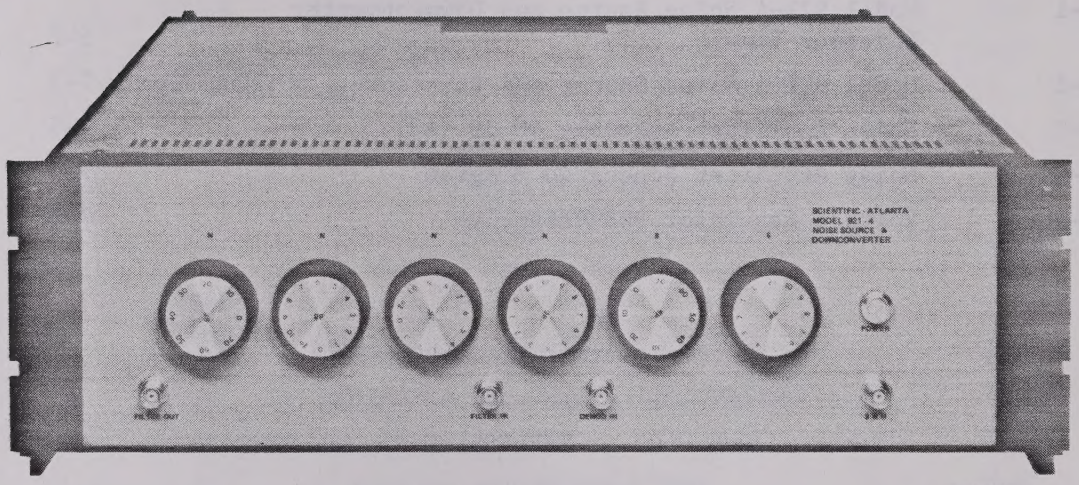

Figure 1-1. Model 921-4 Noise Source and Downconverter

SECTION 1
INTRODUCTION

1.1 GENERAL DESCRIPTION

This manual describes the Scientific-Atlanta Model 921-4 Noise Source and Downconverter (Part No. 196317) and its function. It also provides instructions for installation, operation, theory of operation and maintenance with parts list and drawings supplied for logistics and reference purposes. Each essential component of the unit is described with applicable function and maintenance.

1.1.1 Physical Description

The noise source and downconverter components are contained in a standard 19-inch unit enclosure, capable of being mounted in a standard equipment rack. See figure 1-1. The front panel of the unit has six selector switches, four connectors and a pushbutton on/off power indicator light switch. The rear panel contains input and output connectors and a mounted cooling fan.

1.1.2 Functional Description

The 921-4 Downconverter-Noise test set downconverts an input signal of 1.875425 GHz to 375 MHz, where the signal is combined with a broadband width noise source. Calibrated step attenuators allow calibration of both the noise and downconverted signal levels to generate accurate signal-to-noise ratios. The unit contains a calibrated filter for noise power calibration.

1.2 PURPOSE

The test set provides a method of generating calibrated signal-to-noise ratios. The unit is used in conjunction with the Model 921-1 UQPSK demodulator and the Models 921-2 and 3 Bit Synchronizer Signal Conditioners to test LANDSAT UQPSK modulators.

1.3 TECHNICAL CHARACTERISTICS

Essential primary power and operating characteristics for the Model 921-4 Noise Source and Downconverter are listed in Table 1-1.

TABLE 1-1. MODEL 921-4 NOISE SOURCE AND DOWNCONVERTER TECHNICAL CHARACTERISTICS

Characteristics	Specification (nominal)
Input	
Input Impedance	50 ohms
Input Level	0±10 dBm
Input Frequency	1.875425 GHz ±7.5 KHz
Modulation	UQPSK 4/1
Amplitude Unbalance	±0.25 dB
Phase Unbalance	<±3° peak
Output	
Impedance	50 ohms
Center Frequency	375 MHz
Spurious Response	-45 dBc in band -70 dBc out of band
Phase Noise	1 Hz >38 dBc/Hz
	10 Hz >58 dBc/Hz
	100 Hz >78 dBc/Hz
	1 KHz >108 dBc/Hz
	10 KHz >120 dBc/Hz
	100 KHz >127 dBc/Hz
Minimum bandwidth	≥300 MHz
Noise Spectra Uniformity (in BW)	≤0.5 dB
Noise Type	White Gaussian
Local Oscillator	
Ref Output	75.017 MHz +3 dBm
S+N Output	Variable
Calibrated filter bandwidth	See test data

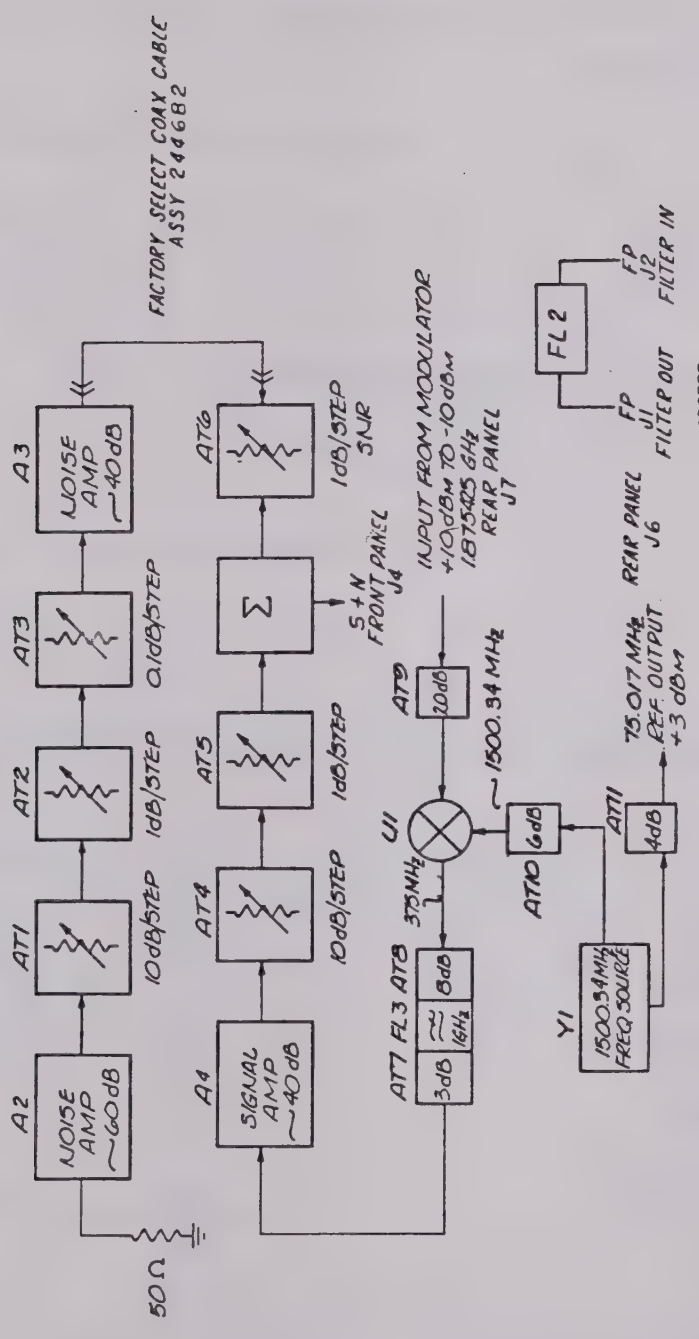

Figure 1-2. Model 921-4 Noise Source and Downconverter Block Diagram

1.4 ASSOCIATED EQUIPMENT REQUIRED

Table 1-2 lists the associated equipment used with the Model 921-4 Noise Source and Downconverter.

TABLE 1-2. ASSOCIATED EQUIPMENT LIST

Component		Part Number
Model 921-1	UQPSK Demodulator	196314
Model 921-2	85.903 Mb/s Bit Synchronizer Signal Conditioner	196315
Model 921-3	15.062 Mb/s Bit Synchronizer Signal Conditioner	196316

TABLE 1-3. RECOMMENDED TOOLS AND TEST EQUIPMENT REQUIRED BUT NOT SUPPLIED

Unit	Quantity	Model	Manufacturer
Data Generator	2	3762A	Hewlett-Packard
Error Detector	2	3763A	Hewlett-Packard
Power Meter	1	435A	Hewlett-Packard
Spectrum Analyzer	1	141T	Hewlett-Packard
Frequency Counter	1	5345A	Hewlett-Packard
Frequency Synthesizer	1	SI-160	Syntest Inc.
Frequency Synthesizer	1	SI-101	Syntest Inc.
Oscilloscope	1	7903	Tektronics
Oscilloscope	1	SEC502	Tektronics

SECTION 2
INSTALLATION

2.1 GENERAL

The Model 921-4 Noise Source and Downconverter unit is supplied with provisions for installation in a standard equipment rack. The unit will conform to standards designated by existing conditions and the installing agency as to unit location and type of installation. This section contains procedures and factors to be considered before installing the unit.

2.2 UNPACKING AND INSPECTION

Exercise caution when unpacking the unit. Carefully open each carton and inspect the unit for shipping damage. If a claim for damage is to be made, save the packing material and shipping carton to substantiate the claim. File the claim with the carrier and notify the local Scientific-Atlanta sales representative immediately. Do not return the unit until shipping instructions have been received from the factory. After all units have been removed from the shipping cartons, check all packing material for small components that may have been wrapped separately. Compare the units received against the packing list. Replace all packing material in the shipping cartons and save the materials for future unit storage or reshipment.

2.3 MOUNTING PROVISIONS

Mounting provisions for the Noise Source and Downconverter unit are shown in figure 2-1. The unit mounting provisions consist of a mounting channel bracket on each side with four slots provided on the front panel for attachment to the equipment rack.

2.4 INSTALLATION

The Noise Source and Downconverter unit is installed in the desired equipment rack location by aligning the four panel slots with the holes in the rack and inserting the mounting bolts and hardware. After the unit has been installed, all connections with the associated equipment should be completed. Table 2-1 provides the cabling connectors, reference designations, functions and types. A rear view of the unit is shown in figure 2-2.

TABLE 2-1. REAR CONNECTORS AND COMPONENTS

Connector/Components	Ref. Design.	Function
Demod OUT/TNC		Connected to front panel demod input.
REF OUT/TNC		Local Oscillator monitor
INPUT/TNC		Input signal from modulator +10 dBm to -10 dBm 1.875425 GHz
Fuse 2A	F1	2-amp SLO-BLO fuse to protect the power supply from power surges
Filter/Plug 1A 115/120V ac	FL1	To filter out static produced by power input
Fan, 4 1/2 in Boxer	B1	To provide cooling for unit components
Ground	G1	To provide grounding of the unit

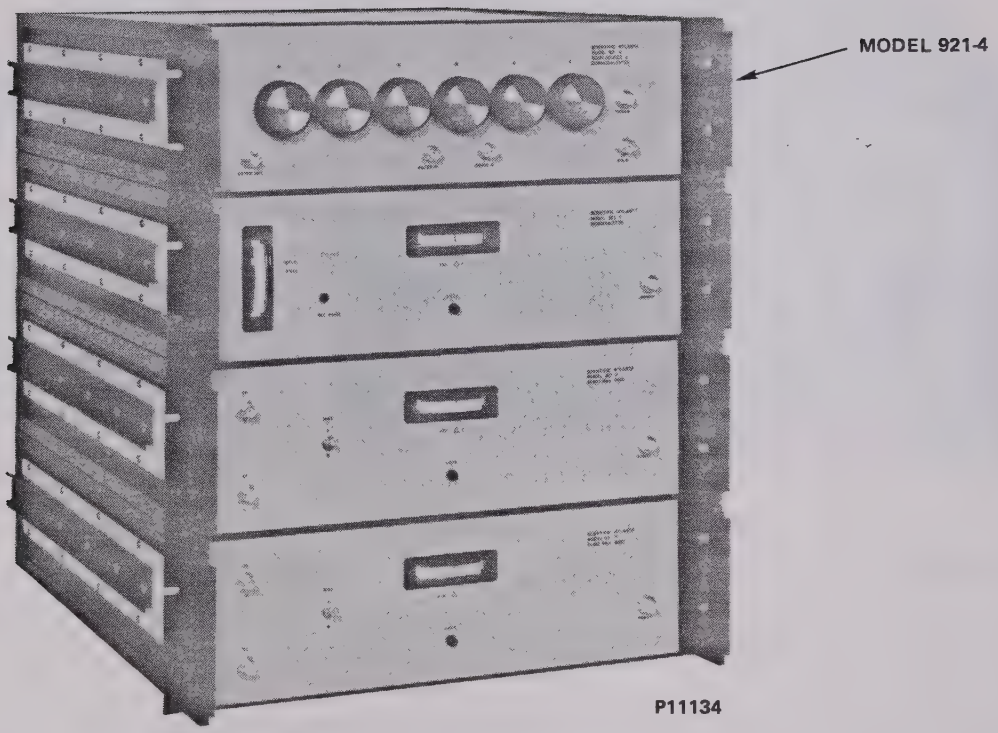

Figure 2-1. Model 921-4 Noise Source and Downconverter Mounting Provisions

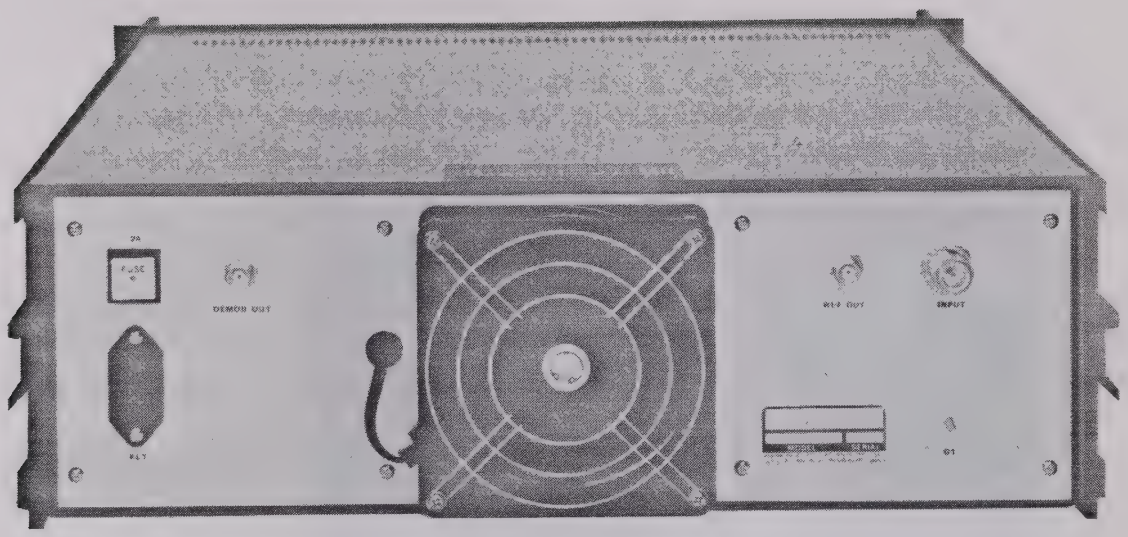

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Figure 2-2. Model 921-4 Noise Source and Downconverter Rear Connections and Components

SECTION 3
OPERATION

3.1 GENERAL

The following paragraphs describe the operating controls and indicators, plus the operating procedure for the Model 921-4 Noise Test Set and Downconverter.

The Model 921-4 downconverts the 1.875425 GHz input signal to 375 MHz, where its level can be controlled in one dB step by the two signal S attenuators. The white noise source may be calibrated to 0.1 dB accuracy by the three left-most noise attenuators N. The center noise attenuator N may then be used to vary the signal-to-noise ratio (SNR) in one dB steps. A filter with calibrated noise bandwidth is accessible from the front panel to allow accurate noise level calibration.

3.2 CONTROLS AND INDICATORS

Table 3-1 lists all front panel controls and connectors. Figure 3-1 shows the location of these controls. Operation is described in the following paragraph.

TABLE 3-1. DETAIL CONTROLS, INDICATORS, AND TEST AND MONITORING POINTS

Controls/Indicators	Function
"N" Attenuators/switch	Sets output noise level
"S" Attenuators/switch	Sets output signal level
FILTER IN/TNC	Input of calibrated filter
FILTER OUT/TNC	Output of calibrated filter
DEMOD IN/TNC	Cabled to rear panel demod out
S & N/TNC	Combined signal plus noise output
POWER Indicator/pushbutton switch	Power ON/OFF indicator switch

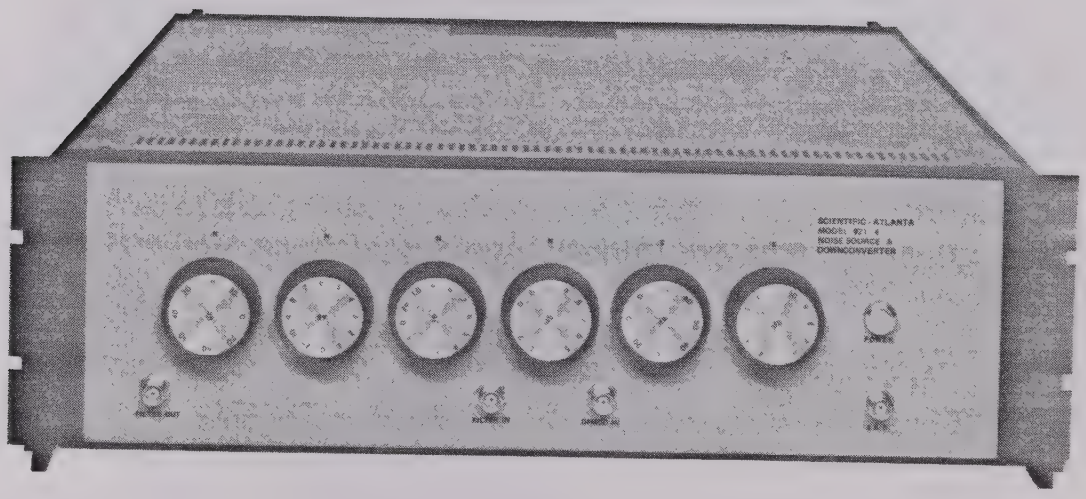

Figure 3-1. Model 921-4 Noise Source and Downconverter Controls and Indicators

3.3 OPERATING PROCEDURE

In normal operation the Model 921-1 Demodulator input is cabled to the DEMOD OUT connector on the rear of the Model 921-4. The modulator is connected to the INPUT on the rear panel. In this configuration the demodulator input is now available at the front panel DEMOD IN connector and the modulator signal is downconverted and available at the S+N output.

In operation the signal level is first set for the desired value using the S attenuators. The noise attenuators are set to maximum to provide a noise-free measurement. Power level is measured with an HP435A Power meter at the S+N output connector. After calculating the desired noise power level for the lowest desired E_b/N_o following the procedure in the Model 921-1 manual, the S+N output is cabled to the "Filter IN" connector and the power level is measured at the FILTER OUT connector. Set the right-most N attenuator to zero and adjust the other three noise attenuators for the desired noise level.

Connecting the S+N output to the demod in provides a calibrated E_b/N_o level. Stepping the right-most noise attenuator increases the E_b/N_o ratio in one dB steps.

SECTION 4
THEORY OF OPERATION

4.1 GENERAL

The following paragraphs describe the theory of operation of the Model 921-4 Noise Test Set and Downconverter.

4.2 OVERALL FUNCTIONAL DESCRIPTION

The unit, shown schematically in figure 4-1, consists of two paths: the signal path and the noise path, which are then combined and connected to the S+N output. The unit is constructed mainly of modular components. The noise source is followed by high-gain amplifiers and adjustable attenuators. The signal path consists of a downconverter, amplifier, and adjustable attenuators. A filter of known bandwidth is also included for calibration of the noise source.

4.3 DETAIL FUNCTIONAL DESCRIPTION

The following two paragraphs describe the detailed operation of both paths.

4.3.1 Signal Path

The incoming signal at 1.875425 GHz is attenuated by 20 dB to insure that the downconverter mixer is operating well below its intercept point. The local oscillator (LO) is a phase-locked cavity microwave oscillator operating at 1.50034 GHz, using a 75.017 MHz internal crystal reference. A reference output monitor is provided. A 6 dB pad between the LO and the mixer insures a good impedance match for the mixer. The output of the mixer is filtered by a 1 GHz low pass filter to remove image and LO frequencies. The filter is padded on both input and output to insure good matching. The output of the

filter is amplified by a 40 dB wideband amplifier before the step attenuators. The attenuators are 10 dB and 1 dB steps.

4.3.2 Noise Path

A 60 dB wideband modular amplifier with a terminated input provides the white noise source. The output of the noise source feeds three step attenuators giving .1 dB resolution. The output of the attenuators is amplified by a 40 dB gain wideband modular amplifier. A 1 dB step attenuator gives 1 dB step SNR final adjustment. A factory selected length of coax between the final amplifier and step attenuator provides a controlled amount of high frequency attenuation to counteract slight peaking of the amplifier response.

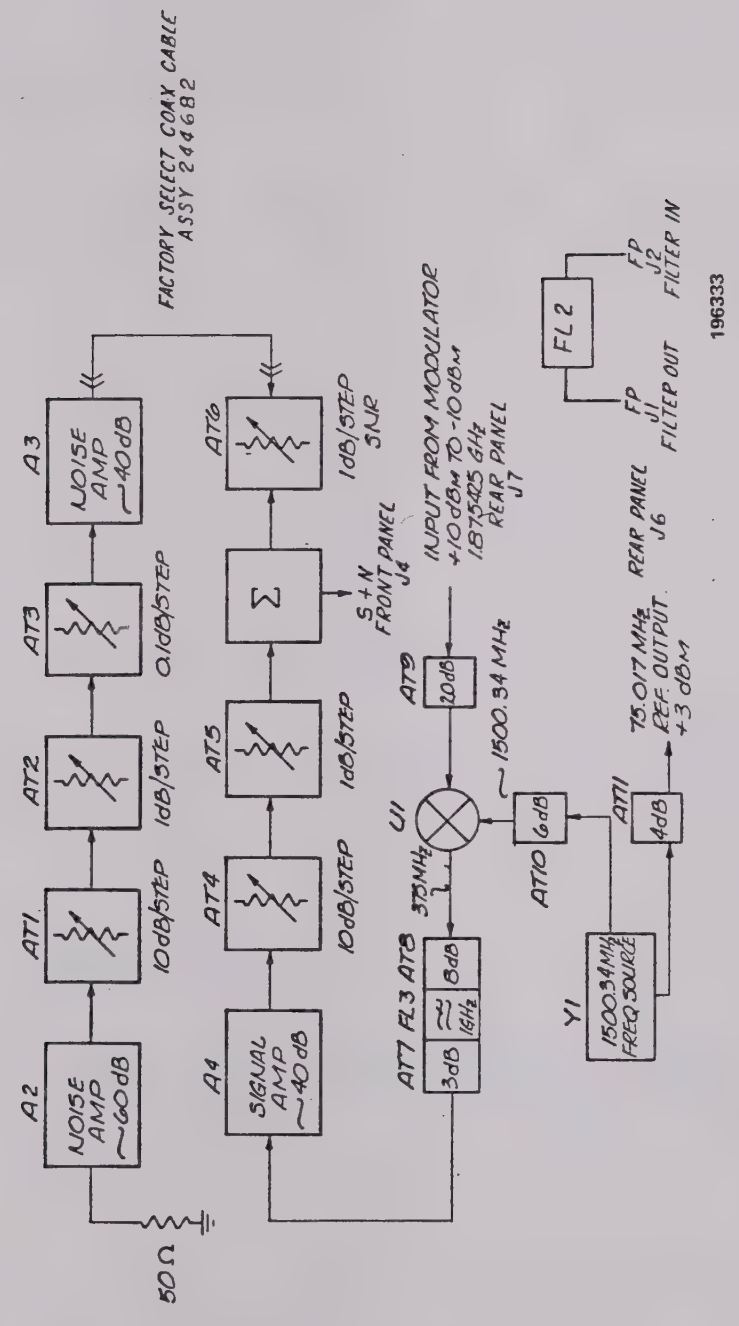

Figure 4-1. Model 921-4 Noise Source and Downconverter Block Diagram

SECTION 5
MAINTENANCE

5.1 GENERAL

This section provides instructions and information relating to preventive and corrective maintenance of the Model 921-4 Noise Source and Downconverter. See figure 5-1 for the interior view of the unit.

5.1.1 Preventive Maintenance Definition

Preventive maintenance includes scheduled inspection, routine test, cleaning and lubrication, and minor repairs and adjustments to aid in preventing malfunctions and improving reliability.

5.1.2 Corrective Maintenance Definition

Corrective maintenance includes troubleshooting which involves symptom analysis, system and circuit level isolation, and repair and replacement of parts to restore the unit to normal operation.

5.2 PREVENTIVE MAINTENANCE

Preventive maintenance includes scheduled inspection, routine tests, cleaning and lubrication, and minor repairs and adjustments.

5.2.1 Inspection and Routine Tests

The unit should be inspected periodically, using the following procedure.

a. Disconnect the unit from the power source.

b. Remove the unit from the equipment rack.

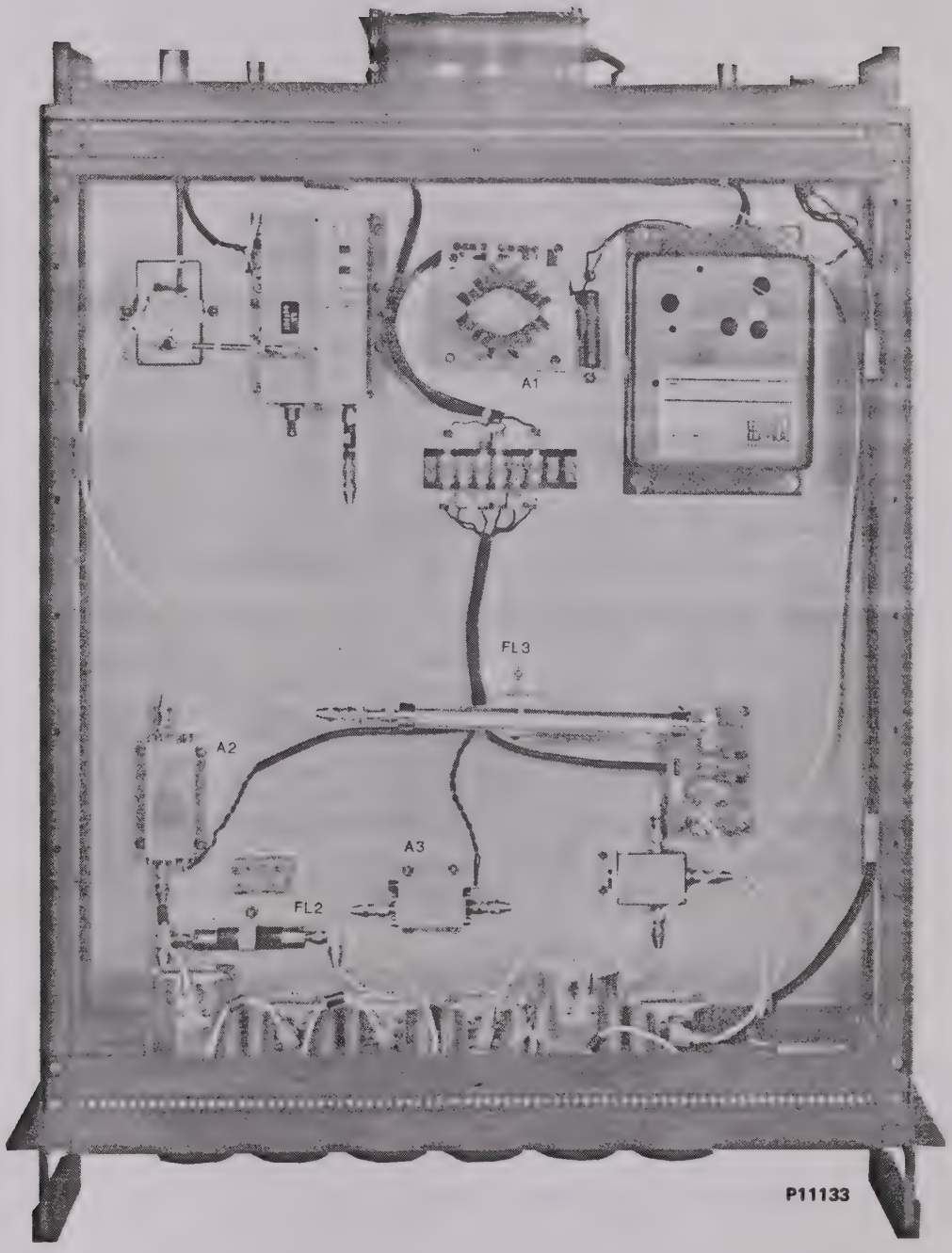

Figure 5-1. Model 921-4 Noise Source and Downconverter Interior View

921-4/Y441

c. Remove cover.

d. Inspect all wiring and cables for frayed, loose, or burned wires.

e. Check cable connections, making sure the plugs are free from corrosion and are properly secured.

f. Check all components for evidence of overheating, breakage, vibration damage, corrosion, or loose connection.

g. Inspect all board components; i.e., capacitors, resistors, transformers and transistors for leaks, distortions and other defects.

h. Any defects found during the inspection shall be corrected immediately.

Routine tests should be conducted during initial turn-on for proper required outputs. If the outputs are above or below set tolerances, check components for damage or loose connections.

5.2.2 Cleaning

The unit should be cleaned as often as operating conditions will permit. Accumulation of dust in the unit can cause overheating and component breakdown. Dust on the components provides an electrical conduction path which acts as an insulation blanket and prevents efficient heat dissipation. The following procedure should be used when cleaning the unit and its components.

a. Using a clean lint-free cloth, lightly moistened with an approved cleaning solvent, remove foreign matter from the unit panel. Wipe dry using a clean dry lint-free cloth.

b. Use a small paint brush to remove dust on or around the front panel controls and rear receptacles.

c. Clean the electrical contacts of the connectors with an approved spray-type contact cleaner.

d. Clean the internal receptacles and circuit boards with a hand-controlled dry jet (not more than 15 lbf/in^2), and a clean lint-free cloth lightly moistened with an approved cleaning solvent. Wipe dry with a lint-free cloth.

5.3 CORRECTIVE MAINTENANCE

The corrective maintenance procedures provided in the following paragraphs include troubleshooting and alignment. The proven circuit design, the use of highly reliable components and recommended preventive maintenance should reduce the possibility of failure. However, if one of the components of the unit should fail, take the following necessary actions.

a. Determine that the failure exists in the component. Eliminate the possibility of external equipment causing the difficulty.

b. Determine the general, then the specific, nature and location of the failure by electrical tests and referring to table 5-1 Troubleshooting Chart.

c. The particular circuit and its location in the unit should be apparent. If the particular circuit is not clearly defined, refer to the circuit description in section 4.

d. Pinpoint and replace the faulty part. Refer to section 7 for the part location and to section 6 for the part number to insure that the correct part has been used.

e. Apply power and observe the component for signs of further failure.

f. Thoroughly test the unit operation associated with the repaired circuit.

TABLE 5-1. TROUBLESHOOTING CHART

Symptom	Probable Cause	Remedy
No Output	Defective power combiner	Replace
	Defective cable	Repair or replace
No noise or reduced noise output	Defective cabling	Repair or replace
	Defective noise amplifier	
No signal or reduced signal output	Defective signal amp	Repair or replace
	Defective LO	
	Defective cabling	
Signal off frequency	Defective LO	Repair or replace

SECTION 6
REPLACEMENT PARTS

6.1 GENERAL

The parts list in this section contains a description of all replaceable components. For information on parts not listed here, consult the factory or your local Scientific-Atlanta representative.

6.2 EXPLANATION OF COLUMN HEADINGS

ITEM:	This is the component designation or find number that appears on the schematic diagram or assembly drawing for that unit.
QUANTITY REQUIRED:	Number of items required for the component.
NOMENCLATURE OR DESCRIPTION:	A brief electrical or mechanical description is given in this column.
MATERIAL SPEC AND SIZE OR COMPONENT VALUE:	Self-explanatory.
IDENTIFYING OR PART NUMBER:	Manufacturer's part number. No part number indicates the part is available from Scientific-Atlanta.
CODE IDENTIFICATION:	Federal Supply Code for manufacturer's Codes is entered here. The code numbers are from the Federal Supply Code for Manufacturer's Cataloging Handbooks H4-1 (Name to Code) and H4-2 (Code to Name) effective on the publication date of this manual.

PARTS LIST

DOWNCONVERTER - NOISE TEST SET

ASSEMBLY PART NUMBER 196317

ITEM OR FIND NO.	QTY REQD.	S-A STOCK NO.	NOMENCLATURE OR DESCRIPTION	MATL SPEC AND SIZE OR COMPONENT VALUE	IDENTIFYING OR PART NO.	CODE IDENT
Ref	0		Assembly Drawing		196317	
Ref	0		Block Diagram		196333	
1	1 ea	193285	Chassis Assembly			
2	1 ea	196309	Front Panel			
3	1 ea	196310	Rear Panel			
4	1 ea	198679	Plate, Bottom Mounting			
5	4 ea	203677	Bracket, Panel Mounting			
6	1 ea	203112	Bracket			
7			Not used			
8	1 ea	203127	Bracket			
9	10 ea	078390	Scr, Dress, 4-40 x ¼			
10	34 ea	072317	Scr, P.H., 4-40 x 1/4			
11	4 ea	072334	Scr, P.H., 4-40 x 5/8			
12	6 ea	072331	Scr, P.H., 4-40 x ½			
13	2 ea	072363	Scr, P.H., 6-32 x 3/8			
14	11 ea	072367	Scr, P.H., 6-32 x ½			
15	8 ea	072378	Scr, P.H., 6-32 x 3/4			
16	46 ea	075937	Washer, Flat #4			
17	46 ea	076779	Washer, Lock, Split, #4			
18	16 ea	076075	Washer, Lock, Int. Tooth #4			
19	27 ea	075939	Washer, Flat, #6			
20	19 ea	073268	Washer, Lock, Split #6			
21	16 ea	075873	Spacer, 4-40 x 3/4			
22	28 ea	071494	Nut, #4-40			
23	19 ea	075446	Nut, #6-32			
24	2 ea	073023	Terminal, Solder Turrent			
25	16 ea	077322	Scr, Taptite 4-40 x ⅛			
26	1 ea	077195	Power Cord, Fan			
27	1 ea	088431	Finger Guard			
28	1 ea	083499	Grommet, Rubber			

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PARTS LIST

DOWNCONVERTER - NOISE TEST SET - continued

ASSEMBLY PART NUMBER 196317

ITEM OR FIND NO.	QTY REQD.	S-A STOCK NO.	NOMENCLATURE OR DESCRIPTION	MATL SPEC AND SIZE OR COMPONENT VALUE	IDENTIFYING OR PART NO.	CODE IDENT
A2	1 ea	TBA	Amplifier Assembly Consisting of: 1 ea UTO 521 Amp 1 ea UTO 533 Amp 1 ea UTO 507 Amp 1 ea TC-4 Case 1 ea TB-3 PWB			24539 24539
A3	1 ea	TBA	Amplifier Assembly Consisting of: 1 ea UTO 533 Amp 1 ea UTO 507 Amp 1 ea TC-2 Case 1 ea TB-2 PWB			
A1	1 ea	196313	Voltage Regulator			
A4	1 ea	196334	Amplifier Assembly			
B1	1 ea	074200	Fan			
FL1	1 ea	088436	Filter - Plug,AC			
FL2	1 ea		Filter, Lowpass		3L120-750-0/0	50140
FL3	1 ea		Filter, Bandpass		2B120-375/85-0/0	50140
F1	1 ea	071226	Fuse, 2A Slo-Blo			
J1-6	6 ea	086211	Conn., TNC			
J7	1 ea	203973	Cable Assy, Semi-Rigid 8"			
PS1	1 ea	082894	Power Supply			
R1-3	3 ea	075587	Resistor, Carbon Composition	¼ 5% 51 ohm	RCR07G510JS	
R4	1 ea	082339	Resistor, Wire Wound	10w 50 ohm	Valid	
S1	1 ea	080116	Switch, Pushbutton			
TB1	1 ea	085622	Barrier Strip			

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PARTS LIST

DOWNCONVERTER - NOISE TEST SET - continued

ASSEMBLY PART NUMBER 196317

ITEM OR FIND NO.	QTY REQD.	S-A STOCK NO.	NOMENCLATURE OR DESCRIPTION	MATL SPEC AND SIZE OR COMPONENT VALUE	IDENTIFYING OR PART NO.	CODE IDENT
J1	1 ea		Mixer, Double Balanced		MA-1	15542
XF1	1 ea	083213	Fuse Holder			
Y1	1 ea		Frequency Source		P1365-1500.34 MHz	53213

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PARTS LIST

INTERMEDIATE POWER AMPLIFIER

ASSEMBLY PART NUMBER 196334

ITEM OR FIND NO.	QTY REQD.	S-A STOCK NO.	NOMENCLATURE OR DESCRIPTION	MATL SPEC AND SIZE OR COMPONENT VALUE	IDENTIFYING OR PART NO.	CODE IDENT
Ref	0		Assembly Drawing		196334	
Ref	0		Schematic		196336	
1	1 ea	196335	PWB			
2	A/R	076627	Solder	Per QQ-S-571E		
AR1,2	2 ea	089341	Amplifier		GPD-1002	
AR3	1 ea	088480	Amplifier		UTO-507	
C1-3	3 ea	083258	Capacitor, Chip	50V .1 mf		
E1,2	2 ea	081765	Core Bead, Ferrite	11 .138X.037X.150L BLU		
J1,2	2 ea		Conn., SMA Female	P.C. Mount Straight	142-0298-001	74790

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PARTS LIST

VOLTAGE REGULATOR ASSEMBLY

ASSEMBLY PART NUMBER 196313

ITEM OR FIND NO.	QTY REQD.	S-A STOCK NO.	NOMENCLATURE OR DESCRIPTION	MATL SPEC AND SIZE OR COMPONENT VALUE	IDENTIFYING OR PART NO.	CODE IDENT
Ref			Assembly Drawing		196313	
Ref			Schematic		196319	
1	1 ea	196318	PWB			
2	A/R	076627	Solder	Per QQ-S-571E		
3	1 ea	077411	Heatsink			
4	2 ea	072363	Screw, Pan Head, SST	6-32 x 3/8		
5	2 ea	073269	Washer, Lock, Ext. Tooth	#6		
6	2 ea	075446	Nut	6-32		
C1	1 ea	076719	Capacitor, Tantalum	35 Vdc 10% 1 mf		
C2,3	2 ea	080139	Capacitor, Ceramic Mono	50 Vdc -20%-+80% .1 mf		
E1	2 ea	081765	Core Bead, Ferrite	11 .138 x .037 x.150Blu		
U1	1 ea	083219	Int. Ckt, Voltage Regulator		MC7815CK	

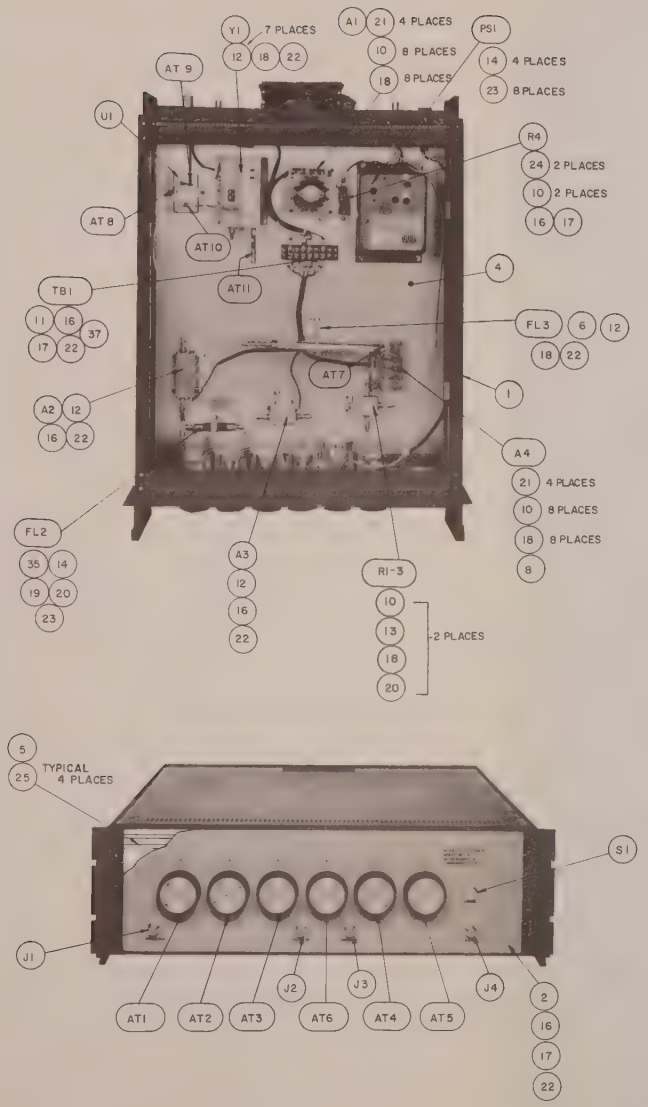
SA433-871

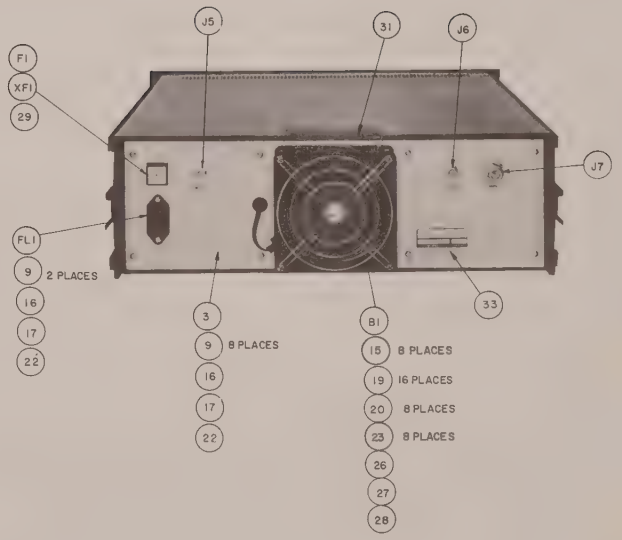
SECTION 7
DRAWINGS AND SCHEMATICS

7.1 GENERAL

The drawings and schematics for the Model 921-4 Noise Source and Downconverter are in this section.

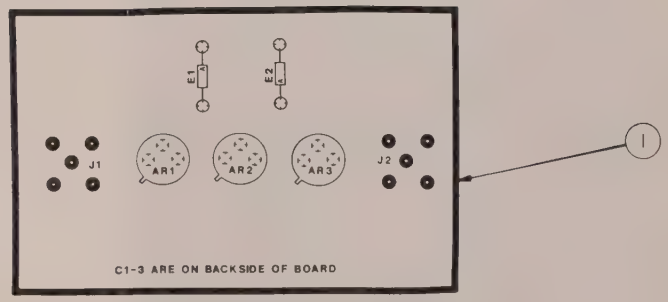
Figure	Title	S-A Drawing No.	Page
7-1	Model 921-4 Noise Source and Downconverter Assembly	196317	7-3
7-2	Noise Amplifier Assembly 40 dB (A3)	196334	7-5
7-3	Noise Amplifier Schematic Diagram	196336	7-7
7-4	Voltage Regulator PWB Assembly	196313	7-9





196317

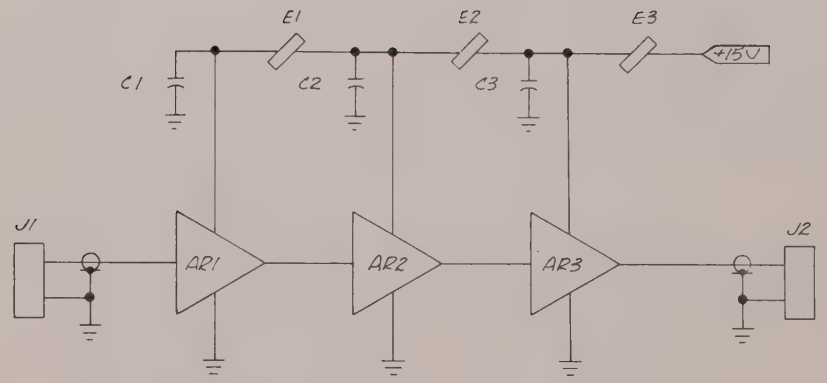
Figure 7-1. Model 921-4 Noise Source and Downconverter Assembly



SEE SEPARATE PARTS LIST

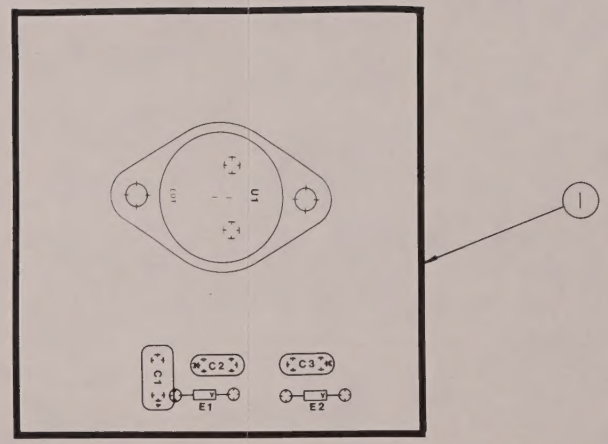
196334

Figure 7-2. Noise Amplifier Assembly 40 dB (A3)



196336

Figure 7-3. Noise Amplifier Schematic Diagram



SEE SEPARATE PARTS LIST

196313

Figure 7-4. Voltage Regulator PWB Assembly

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